DISSERTATION ON

SCREENING OF TERM LOW BIRTH WEIGHT INFANTS FOR NEURODEVELOPMENTAL DELAY

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CERTIFICATE

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CONTENTS

INTRODUCTION

In an increasingly competitive world it is essential to ensure that a child grows and develops to its full developmental potential. We are now in a position in our country to save the lives of a number of LBW, asphyxiated and sick babies. As more of these babies survive, the chances of childhood developmental delay, speech problems, behavioral problems, attention deficit hyper kinetic disorder and scholastic backwardness increases. If these children are followed up and problems in development are identified and treated early, these very children would be given a chance for optimum development.

This highlights the need for adopting early detection practices for developmental delay, subsequently leading on to early intervention therapy. Another issue is the feasibility of technology necessary for the implementation of the above process. It is true that there are many sophisticated, scientific methods for the assessment of development in children, but what we need is simple screening procedures which can be used in the community.

The pediatrician must play a pivotal role in identifying developmental disability since he is the one who gets uniquely involved in the care of the infant. Unfortunately in actual practice, it doesn't often happen. The major reason appears to be much-too-much load on the pediatrician in busy settings.

And perhaps, a notion on the part of a substantial proportion of the pediatricians that developmental screening is not only time-consuming but also the domain of Neurologist/Psychiatrist.

How untrue! In a recent internet study, under the aegis of pediatric education and communication network (PECN), 72% European, 70% American and only 20% Indian Pediatricians said, they were routinely carrying out some form of developmental screening in their general practice.

About 25 to 35 percent of babies in India are LBW as opposed to about 5 to 7 percent of newborns in the west. High Incidence of LBW babies in our country accounted for by a higher number of babies with intrauterine growth retardation (small for dates) rather than the preterm babies. The neurodevelopmental sequelae are more common in LBW babies compared to their normal weight counterparts[13].

HISTORICAL ASPECTS:

Charles Darwin was the first to publish a detailed record of child development, including observation on crying, sobbing, laughter and other emotions in “The Expression of the Emotions in man and animals” (1872) and “A Biographical sketch of an infant” (1877) followed by Shin in 1893 and Shirley in 1931.

Stern and Kehlman in 1912 gave the concept of intelligent quotient, the ratio between assessed mental age and actual chronological age.

In early and mid 1990s, Arnold Gessel followed by Knobloch, Paramanick, Ruth Griffiths and others published norms of development on a large number of children.

In 1967, the famous Denver Developmental Screening Test was documented. It was based on a sample of 1000 selected children. It assessed development of infants and children (usually up to 3 years) in 4 vital area namely gross motor, fine motor, language, and personal social behavior. There were 105 items, some indeed difficult to administer. Moreover it was not quite appropriate for children and mothers who were not having enough education. In addition, it had fewer items related to

language. As a short cut, a “short” DDST became available but it had got to be followed up by the full DDST subsequently for dependable results.

In 1981, a major revision, modification and standardization of the original. DDST occurred in the form of Denver II which has 125 items instead of 105 and yet takes only 5-7 minutes. Other plus points of Denver II over DDST include availability of Denver II screening manual, availability of Denver II Training manual, availability of a video instructional program and proficiency test. Make no mistake that it is only a screening test for identifying children who are not performing in keeping with their age, irrespective of the reason(s). It undoubtedly doesn’t measure intelligence (or) developmental quotient. Attempts are on way to produce a short (abbreviated) Denver II needing just 5 min for assessment. At this stage, remember the major limitation of DDST lies in its wrong use as an IQ test, which it indeed is not.

About the same time, Boel tests for visual auditory and tactile sense emerged on the scene for use in infants aged 7-9 months. In these tests, a red object is employed to attract usual attention; four bells attached to the testers fingers attract auditory attention.

The other development screening tests that appeared on the scene included Brazelton & Dubowitz tests, Gessel DST, Bayley DST,

woodside DST, developmental profile (DP-II), cognitive adaptive test/clinical linguistic auditory milestone scale (CAT/CALMS), early language milestone scale (ELM) and Vineland social maturity scale.

In India, Phatak from Baroda (now Rechristined Vadhodhare) adopted Baroda screening test from Bayley developmental scale to suit the Indian infants and children, aged 0-36 months. Domains evaluated are gross motor, fine motor and cognitive. Administration time is 10 min. Sensitivity is 0.66-0.93, while specificity is 0.77-0.94.

Yet another test developed in India, Trivanderum Developmental Screening Test is based on Baroda norms. It has 17 items and is relevant for age 0-2 years. Domains evaluated are gross motor, fine motor and cognitive. Administrative time is 5 min. validity and specificity are 0.67 and 0.79 respectively.

LBW BABIES:

Babies with a birth weight of less than 2.5 Kg, irrespective of the period of their gestation, are classified as LBW babies. These include both preterm and term small-for-dates babies. Their clinical problems and prognosis are quite different from each other. About 25 to 35 percent of babies in India are LBW as opposed to about 5 to 7 percent of newborns in the developed countries. In India alone 6 to 8 million LBW infants are born annually. High incidence of LBW babies in our country is accounted for by a higher number of babies with intrauterine growth retardation (small-for-dates) rather than the preterm babies.

Birth weight is the single most important marker of adverse perinatal, neonatal and infantile outcomes. Over 80 percent of all neonatal deaths, in both the developed and developing countries, occur among the LBW babies. LBW is also a major determinant of malnutrition during infancy because over 40 percent of LBW babies are malnourished at one year of age[13].

LBW infants have 2-3 times increased risk of mortality due to infections compared to normal birth weight babies after controlling for all confounding variables. The neurodevelopmental sequelae are more common in LBW babies compared to their normal weight counterparts[13].

“There is no indicator in human biology, which tells us so much about the past events and the future trajectory of life, as the weight of infant at birth”.

Neurodevelopmental assessment:

Assessment is defined as obtaining information about the skills and potentials of individuals.

- Every baby follows his or her own unique schedule of development within fairly broad limits.
- Assessment may take on special significance in a suspected developmentally abnormal infant.
- The score obtained is not an IQ score, but rather a relatively short term, best estimate of developmental progress.
- It can prove useful in detecting the precursors of later impairment.
- Despite limitations, assessment techniques continue to be effective means of identifying infants at risk for developmental disabilities.

- Identification of risk status can lead to early intervention services aimed at prevention and amelioration of potential problems.

Developmental assessment is conducted

To determine the existence of a developmental delay.

- To identify strengths and needs
- To develop strategies for intervention
- To determine progress on significant developmental achievements
- To serve as a basis for reporting to parents.

Developmental screening test:

Several developmental screening tests are available for use in infants & children. It is recommended that screening test should be simple, brief, and convenient to use, cover all areas of development, have adequate construct validity, be applicable to a wide age range, and have referral criteria that are both specific and sensitive. Good developmental screening tests have sensitivities and specificities of 70% to 80% largely because of the nature and complexity of measuring the continuous process of child development. Developmental screening is important to parents, to obstetrician, to neonatalogists and to pediatricians. Let's see how in the following paragraphs

First thing First! Every parent is eager to know if the child is developing normally, especially if there is history of a miscarriage or still birth, mental retardation physical disability, maternal infection, diseases or drug abuse. Developmental screening is therefore an essential prerequisite for development assessment and subsequently for a corrective intervention

Who is the best for development screening Pediatrician or psychologist?

As an accepted convention a pediatrician is supposed to base his development screening on detailed history and physical examination with special reference to development examination, some investigation and the overall interpretation of the whole spectrum. This is absolutely logical because of large number of factors (prenatal, natal, and postnatal) have a significant bearing on child's development.

The pediatrician must obtain relevant information in relation to these factors if he is to reach the right conclusion about the developmental quotient. The pediatrician should be reassuring but only up to a point. In no case should he dismiss parental developmental concerns prematurely in his over enthusiasm to provide support and advocacy to parent. The probability of premature reassurance becomes most likely when the child has normal motor ability or when he is cute, sweet, alert or sociable. The pediatrician's role should therefore be considered "central" in early and fair identification of developmental defects. Once developmental delays are identified, he is also expected to have the full evaluation and provide support to the child and the family to maximize child's potential abilities.

In contradistinction, the psychologist is not much bothered about the history and physical examination, and depends by and large on the purely objective tests based on scoreable items of behavior. His major goal is a unitary figure or score for assessment. This approach is likely to lead to fallacies.

It needs to be emphasized yes, even at the expense of repetition that, when in doubt about the real status of the child. It is always wise to reexamine him and if found necessary, to advise the parents to come for follow-up. But, remember this must be done without causing worry to parents.

Parent's opinion as a prescreening developmental test:

Eliciting parents concerns about child's developmental status is on the threshold of emerging as an important prescreening procedure for detecting developmental delay. Studies have shown that parents who express concerns about speech, language, and fine motor or cognitive skills have children with an 80% chance of failing standardized developmental screening. In a recently concluded study from Chandigarh, India, it has been demonstrated that parents of delayed children very often do not raise global / cognitive concerns and are more likely to raise social, gross motor, behavior, expressive language and medical concerns

(E.g. not growing well, remains sick, not eating). We do agree the suggestion the “Pediatrician’s should routinely and carefully elicit parents opinion and concerns which need to be viewed as helpful adjuncts to routine assessment and should be used to make appropriate referrals.

EARLY INTERVENTIONAL THERAPY:

Early stimulation is now well established strategy for preventing or reducing disability resulting from early CNS damage. When there is neuronal damage during prenatal period and infancy, pruning of the spared synapses and relocation of the activity of the damaged neurons is possible if the spared synapses could be saved by stimulation. Early intervention improves the neurodevelopmental outcome by preventing active inhibition of the CNS pathways due to inappropriate input and supporting the use of modulating pathways during a highly sensitive period of brain development. Developmentally supportive care may be associated with improved cortical and specifically frontal lobe development from early on. This explains the positive lasting effects into school age.

LITERATURE REVIEW

A study on Neurodevelopmental, Functional and growth status of term LBW Infants at 18 months of age was conducted by Department of Pediatrics, Maulana Azad Medical College and Associated Lok Nayak Hospital, New Delhi[4]. This study was done to evaluate the neurodevelopmental, functional and growth status of term infants weighing 2 Kg or less at birth at 18 months of age. All Infants were assessed for growth, audiovisual, neurological impairment and motor and mental development using Baroda developmental screening test. Term infants with birth weight of more than 2.5 Kg without any antenatal (or) neonatal complications served as controls. 50 LBW term infants and 30 controls were evaluated. The mean developmental quotient for LBW infants [91.51 (16.97)] was significantly lower than that of control [102.02(8.4)]. Neonatal complications were associated with an abnormal motor outcome. They concluded that term LBW outcomes are at significant disadvantage in term of growth and mental scores at 18 month of age.

A study conducted by Frances Williams[5] on 105 children who had weighed less than 1500g at birth using Wechsley, Gestalt and reading tests showed that the mean IQ for the small for dates children was 92, as compared with 99.2 for those appropriate for dates.

A study conducted by American[9] collaborative of 259 long term survivors who had weighed 500 – 1500 g at birth, seen at 2 years of age showed that 18.6% had a major handicap of cerebral palsy, mental sub-normality or epilepsy.

A study conducted by Finland[12] of 57 Survivors whose birth weight was 1500 g or less showed that four had severe mental or physical defects. The others were less good than controls in motor and speech development and behavior in school.

A study conducted by Canadian[16] of 110 children whose birth weight had been 500 – 1000 gm, followed for a minimum of 2 years showed that 24% had sensory handicaps, 26% neurological handicaps, and remainders were normal.

A follow up study conducted by Yu and colleagues[17,18] in Australia of 261 infants weighing 500 – 999 gm at birth showed that the 7-year survival rate was 46% of 108 survivors followed for at least 2 years, 28% had a disability.

A follow up study conducted by Hirata[7] of 24 survivors with a birth weight of 501 – 750 g, who were small in weight and head size, four had low intelligence, two had neurological squealer and the rest were normal.

A follow up study conducted by Cohen[3] of 87 survivors whose birth weight had been 751 – 1000 g, Eight died later, four could not be traced. Of the 72 remaining at 3 years, four had severe and 14 moderate handicaps.

A 5 year follow up study conducted by Klein[10] of 80 with a mean birth weight of 1.2 Kg noted the frequency of visual and perceptual difficulties even when the IQ was normal.

A study conducted by Department of community health systems, University of California on 108 LBW infants showed the relationship between Maternal tactile stimulation and the neurodevelopment of LBW infants. The findings of the study suggest that stimulation and frequent touch may help to compensate for early neurosensorydeficits and promote neurodevelopment for LBW infants.

This literature review reveals that neurodevelopmental delay was more common among LBW infants. It was also observed from the study

that all LBW infants, even Low risk populations are at significant disadvantage in term of growth and mental scores. It was also found that early intervention improves the neurodevelopmental outcome among LBW infants.

STUDY JUSTIFICATION

In developing countries like India, though malnutrition and communicable diseases are still the major health hazards, there has been a welcome shift towards better care of neonates both in routine care and care of high risk neonates.

The development of health infrastructure and effective tertiary level care has decreased the mortality rates, thus shifting the emphasis to morbidity pattern.

About 25 to 35 percent of babies in India are LBW as opposed to about 5 to 7 percent of Newborns in the developed countries.

This study is expected to provide insight into the neurodevelopmental outcome among term LBW infants.

The use of simplest, easiest and less time consuming screening test for neurodevelopmental assessment by pediatrician in out-patient clinic will be identified by this study which will help in early identification and intervention.

STUDY OBJECTIVES

To assess the neurodevelopmental outcome of term LBW infants using Trivandrum developmental Screening Test, Baroda developmental screening test and Denver Developmental Screening Test – II.

To compare the neurodevelopmental outcome as assessed by Trivandrum developmental screening test, Baroda developmental screening test and Denver Developmental Screening test.

STUDY METHODOLOGY

This study was conducted in two phases.

Phase I :- Prospective cross sectional study with follow up.

Phase II :- Retrospective cross sectional study.

Phase I Study:

It was conducted at Kasturibai Gandhi Hospital, Madras Medical College, a tertiary care Hospital in Chennai, during the period from January 2007 to September 2008 on term neonates with a gestational age of 37-42 weeks with a birth weight of less than 2.5kg.

Phase II Study:

It was conducted at Institute of Child Health and Hospital for children, Madras Medical College, a tertiary care children hospital in Chennai, during the period from July 2008 to September 2008 on term neonates with a gestational age of 37-42 weeks with a documented birth weight of less than 2.5kg.

EXCLUSION CRITERIA:

- Preterm babies
- Hypoxicischemicencephalopathy
- Neonates with Sepsis (positive blood /CSF culture)
- Severely dysmorphic neonates with atleast one major congenital anomaly
- Neonates with Hepatosplenomegaly and cataract indicative of Intrauterine infection.
- Neonatal seizure / Jaundice requiring exchange transfusion

SAMPLE SIZE:

Based on previous studies, the incidence of neuro-developmental outcome in neonates with LBW was expected to be about 30%. Using 99% confidence interval the calculated sample size was 140.

MANOEUVERE:

Phase I – The study was conducted at Kasturibai Gandhi Hospital between the period of January 2007 and September, 2008. The neonates were enrolled during the first three months of the study period and followed up for a period of one and half year.

All neonates included in the study were registered at birth. The Sex of the baby, birth weight and gestational age was recorded in the data collection form. The details regarding the presence of Antenatal illnesses, mode of presentation and delivery were obtained by interviewing the mothers. Every enrolled newborn was followed up during the hospital stay for the presence of neonatal illness, seizure, jaundice and any congenital malformation.

At the time of discharge from the hospital, babies were examined; weight, length, Head circumference and chest circumference were recorded for every new born. The parents were counseled regarding the neurodevelopmental outcome of LBW and the need for follow up and periodic developmental assessment. A Development assessment card was issued to every newborn, with details of follow up dates. The infants were followed up at 3, 6, 9, 12 and 18 months of age. At each visit, the child's weight, length, Head circumference and chest circumference were noted.

The child's development was assessed by Trivandrum developmental screening test, Baroda (Abbreviated Bayley scale of Infant development) and Denver developmental Screening Test – II.

Phase II – This study was conducted at the Institute of Child Health and hospital for children between the period of July 2008 and September 2008. All neonates with a documented birth weight (Term, LBW) were identified in out patient clinic and enrolled in this study. The details regarding Birth weight, gestational age, Presence of antenatal illnesses, mode of presentation and delivery were obtained by interviewing the mothers. The parents were informed regarding the neuro-developmental assessment. The child's development was assessed by Trivandrum developmental screening test, Baroda developmental screening test and Denver developmental screening test = II.

TRIVANDRUM DEVELOPMENTAL SCREENING TEST

A simple developmental screening test designed and validated at the child development centre, Trivandrum. There are 17 test items in the chart, carefully chosen after repeated trial and error. The age range for each test item is taken from the norms given in the Bayley scales of Infant development.

Age range: 0 – 2 years.

Test material: A pen and a bunch of key are probably the thing required.

Test: A vertical line is drawn or a pencil is kept vertically, at the level of the age of the child (in months) being tested. If the child fails to achieve any item that falls short on the left side of the vertical ine, the child is considered to have a developmental delay.

BARODA DEVELOPMENTAL SCREENING TEST:

In BDST, the performance of the child was noted by plotting the total number of items passed by him/her (score) against the chronological age. The intersection of the horizontal level of this score with the 50% level curve indicated the developmental age of the child i.e. the age at with 50% normal children are expected to have the same scale.

The developmental quotient was calculated as follows:

Developmental age / chronological age X 100

If the child's developmental Quotient was 77.5 (-1.5 SD) or less, the child was considered to have delayed development.

DENVER DEVELOPMENTAL SCREENING TEST – II

- Age range: 2 weeks to 6 years

- This test was designed to be a quick and simple screening tool to be used in clinical settings by people with little training in developmental assessment. The test is comprised of 125 items, divided into four categories:
    - Gross – motor
    - Fine motor / adoptive
    - Personal social
    - Language

The items are arranged in chronological order according to the ages at which most children pass them. The test is administered in 10-20 minutes and consists of asking the parent questions and having the child perform various tasks. The test kit contains a set of inexpensive materials.

The test items are represented on the form by a bar that spans the age at which 25% 50% 75% and 90% of the standardization sample passed that item. The child's age is drawn as a vertical line on the chart and the examiner administers the items bisected by the line. The child's performance is rated pass, caution or delay depending on where the age line is drawn across the bar. The number of delays or cautions determines

the rating of Normal, Questionable, or abnormal. At the end of one and half year neurodevelopmental outcome was analyzed and the results are as follows.

In the analysis of neurodevelopmental outcome, we have grouped the test items of all three screening tests together so as to compare the items passed or failed by the term low birth weight infants by those three screening tests, easily.

RESULTS

In Phase I study the infants were enrolled from January 2007 to March 2007 and they were followed up for a period of one and half year from the date of enrollment.

Among the 200 term LBW infants, 50 of them were excluded after applying the exclusion criteria. The remaining 150 were followed up their parents were counseled and development assessment cards were issued at the time of discharge. None of them were lost follow up. At the end of the study period, 150 of them had completed the follow up.

In phase II study, 234 term LBW infants were enrolled. Among the 234 term LBW infants that were enrolled, 104 were assessed at the age of 6 months, 78 were assessed at the age of 9 months, 52 were assessed at the age of 1 year.

The observations were analyzed under the following heading:-

i. Baseline data

ii. Analysis of the risk factors for neurodevelopmental outcome.

iii. Analysis of neurodevelopmental outcome as assessed by Trivandrum developmental screening test, Baroda developmental screening test and Denver developmental screening test II.

BASELINE DATA

The demographic details of the study Population were analyzed in the following ways:-

I. PROSPECTIVE CROSS SECTIONAL STUDY:

1. Demographic Details of LBW Infants:

a. Sex Distribution among LBW infants:

Sex	**n**	**%**
Male	86	57.33
Female	64	42.66

Among the LBW who were followed by 57.33% were males, 42.66% were females.

b. Birth weight distribution among term LBW infants

Birth Weight	n	%
2 Kg – 2.5 Kg	98	65.33
1.5 Kg – 2.5 Kg	52	34.66
< 1.5 Kg	-	-

Among the term neonates who were followed by 65.33% were LBW with a birth weight of 2 Kg – 2.5 Kg, 34.66% were LBW with a birth weight of 1.5 Kg to 2 Kg.

2. Demographic Details of LBW Infants Mothers:

Antenatal illnesses among mother with LBW infants:

Antenatal Illnesses	n	%
Anemia	62	41.33
PIH	11	7.33
GDM	4	2.66
Infection	21	14
APH	33	22
Nil	52	34.66

Among the mothers with LBW babies, 34.66% had normal antenatal period 41.33% had anemia, 7.33% had PIH, 2.66% had GDM, 14% had infection, 22% had APH.

MODE OF PRESENTATION:

Presentaion	n	%
Vertex	118	78.66
Breech	32	21.33
Others	0	0

Among the LBW who were followed by 78.66% had vertex presentation 21.33% had Breech presentation.

MODE OF DELIVERY:-

Mode of Delivery	n	%
Normal vaginal delivery	98	65.33
LSCS	52	34.66
Vacuum / Forceps	0	0

Among the LBW who were followed by 65.33% had normal vaginal delivery, 34.66% had LSCS.

II. RETROSPECTIVE CROSS – SECTIONAL STUDY:

DEMOGRAPHIC DETAILS OF LBW INFANTS:

Sex Distribution among LBW infants:

Sex	n	%
Male	132	56.41
Female	102	43.58

Among the LBW who were followed by 556.41% were males 43.58% were females.

Birth Weight Distribution Among Term Lbw Infants:

Birth Weight	n	%
2 Kg – 2.5 Kg	130	55.55
1.5 Kg – 2.5 Kg	72	30.76
< 1.5 Kg	32	13.67

Among the term neonates who were followed by 55.55% were LBW (with a birth weight of 2 Kg – 2.5 Kg), 30.76% were LBW (with a birth weight of 1.5 Kg – 2.5 Kg) and 13.67% were very LBWs (<1.5 kg)

DEMOGRAPHIC DETAILS OF LBW INFANT MOTHERS:

Antenatal Illnesses Among Mother With Lbw Infants:

Antenatal illnesses	n	%
Anemia	93	39.74
PIH	33	14.10
GDM	5	2.13
Infection	53	22.64
APH	22	9.4
Nil	96	41.02

Among the mothers with LBW babies, 39.74% had anemia, 14.10% had PIH 2.13% had GDM, 22.64% had infection, 9.4% had APH, 41.02% had normal antenatal period.

MODE OF PRESENTATION:

Presentation	n	%
Vertex	183	78.20
Breech	46	19.65
Others	5	2.13

Among the LBW who were followed by 78.20% had vertex presentation. 19.65% had Breech presentation, 2.13% had transverse lie presentation.

MODE OF DELIVERY:

Mode of delivery	n	%
Normal vaginal delivery	140	59.82
LSCS	88	37.60
Vacuum / Forceps	6	2.56

Among the LBW who were followed by 59.82% had normal vaginal delivery, 37.60% had LSCS, 2.56% had forceps delivery.

Analysis of the risk factors for outcome:

Predictors of neurodevelopmental outcome among term LBW infants:

Risk Factors	Developmental Delay		No. Developmental Delay		P – Value
	n	%	n	%	
Sex :-					
Male	13	9.84	119	90.15	OR = 0.04 P = 0.97
Female	9	8.82	93	91.17	
Antenatal	**n**	**%**	**n**	**%**	**P – Value**

Illnesses:-					
Anemia	12	12.9	81	87.09	OR = 3.34 P = 0.001 (95% CI 5 - 20)
PIH	7	21.21	26	78.78	OR = 4.1 P = 0.001 (95% CI 5 - 37)
GDM	0	0	5	100	-
APH	10	45.45	12	54.54	OR = 6.48 P = 0.001 (95% CI 21 – 69)
Infection	4	7.54	49	92.45	OR = 2.30 P = 0.03 (95% CI 1-16)
Nil	0	0	96	100	-

Risk Factors	**Developmental Delay**		**No. Developmental Delay**	
	n	**%**	**n**	**%**
Mode of Presentation				
Vertex	19	10.38	164	89.61
Breech	3	6.52	43	93.47
Others	0	0	6	100
P = 0.5 – Statistically not significant				
Mode of Delivery	**n**	**%**	**n**	**%**

Vaginal Delivery	15	10.71	125	89.28
LSCS	7	7.95	81	92.04
Vacuum / Forceps	0	0	6	100
P = 0.57 – Statistically not significant				
Birth Weight:-	**n**	**%**	**n**	**%**
2 Kg – 2.5 Kg	0	0	130	100
1.5 Kg – 2 Kg	0	0	72	100
< 1.5 Kg	22	68.75	10	31.22
P = 0.001 – Statistically significant				

From the analysis of the risk factors for neurodevelopmental outcome, it was found that the Sex of the neonate, mode of delivery and presentation did not have statistically significant association with neurodevelopmental outcome

From the Phase – II study, it was found that antenatal illeness such as anemia, pregnancy induced hypertension, antepartum haemorhage and infection have statistically significant association with neurodevelopmental outcome, but the percentage of Antenatal illnesses among mothers with LBW infants were similar in both Phase – I and Phase – II study. From the comparison of those 2 studies, it was found that antenatal illnesses have statistically

significant association with neurodevelopmental outcome only among very Low birth weight infants rather than Low birth weight infants.

PHASE I :- PROSPECTIVE CROSS SECTIONAL STUDY WITH FOLLOW UP

Profile of developmental delay – assessment at 3 months of age by Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Equal Movements	150	-				
2. Lift head	150	-				
3. Head up 45	150	-				
4. Head up 90	150	-				
5. Sit with head steady	150	-				
6. Arms & Legs thrust in play			150	-		
7. Lateral head movement			150	-		
8. Head erect and steady			150	-	150	-
B. LANGUAGE						
1. Respond to bell	150	-				
2. Vocalises	150	-				
3. Cooing	150	-				

4. Laughs	150	-				
5. Squeals	150	-				
6. Responds to sound			150	-		
C. FINE MOTOR						
1. Follow to Midline	150	-				
2. Follow past midline	150	-				
3. Grasp rattle	150	-				
4. Hands together	150	-				
5. Momentary regard			150	-		
6. Follows moving person			150	-		
7. Free Inspection of surrounding			150	-		
8. Eye coordination			150	-		
9. Eyes follow pencil					150	-
D. PERSONAL SOCIAL						
1. Regard face	150	-				
2. Smile responsively	150	-				
3. Smile spontaneously	150	-				
4. Regard own hands	150	-				
5. Social smile			150	-	150	-

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 3 months of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 3 months of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 3 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 3 month of age.

For the neurodevelopmental assessment at 3 month of age, there are 19 test items in Denver II, there are 9 test items in Baroda screening test and only 3 test items in Trivandrum developmental screening test. All the items were passed by the 150 term LBW infants. Thus it indicates that all three screening test are equally sensitive in identifying normal development among term LBW Infants at 3 month of age.

Profile of developmental delay – assessment at 6 months of age by Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Bear weight on legs	150	-				
2. Chest up with arm support	150	-				
3. Roll over	150	-				
4. Pull to sit-no head lag	150	-				
5. Sit no support	150	-				
6. Holds head study			150	-		
7. Elevates on arms			150	-		
8. Sit with slight support			150	-		
9. Turn from back to side			150	-		
10. Rolls from back to stomach					150	-
B. LANGUAGE						
1. Turn to rattling sound	150	-				
2. Turn to voice	150	-				
3. Single syllable	150	-				
4. Imitate Speech	150	-				
5. Play with rattle			150	-		
6. Turns head to sound			150	-		
7. Turn head to sound of bell					150	-
C. FINE MOTOR						
1. Follow 180	150	-				

2. Regards raisin	150	-				
3. Reaches	150	-				
4. Look for yarn	150	-				
5. Breaks raisin	150	-				
6. Passes cube	150	-				
7. Reaches for dangling ring			150	-		
8. Objects hand to hand					150	-
D. PERSONAL SOCIAL						
1. Work for toys	150	-				
2. Feed Self	150	-				
3. Recognizes mother			150	-		
4. Exploitive paper play			150	-		

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 6 months of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 6 month of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 6 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 6 month of age.

For the neurodevelopmental assessment at 6 month of age there are 17 test items in Denver II, there are 9 items in Baroda screening test, and 3 items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening test are equally sensitive in identifying normal development among term LBW infants at six month of age.

Profile of developmental delay – assessment at 9 months of age by Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Stand holding on	150	-				
2. Pull to stand	150	-				
3. Get to sitting	150	-				
4. Pull to sit			150	-		
5. Sits alone steadily			150	-		
6. Pulls to stand			150	-		
7. Sits with good coordination			150	-		
8. Raises self to sitting position					150	-
9. Standing up by furniture					150	-
10. Walk with help					150	-
B. LANGUAGE						
1. Dada – mama non specific	150	-				
2. Combine syllables	150	-				
3. Blabbering	150	-				
C. FINE MOTOR						
1. Take 2 cubes	150	-				
2. Thumb finger grasp	150	-				
3. Bang 2 cubes held in hands	150	-				
4. Bangs in play			150	-		
5. Retails 2 things in hands			150	-		

6. Fine prehension pellet					150	-
D. PERSONAL SOCIAL						
1. Play pat a cake	150	-				
2. Imitate wants	150	-				
3. Discriminates strangers			150	-		
4. Playful response to mirror image			150	-		
5. Pat a cake					150	-

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 9 month of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 9 month of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 9 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

DST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 9 month of age.

For the neurodevelopmental assessment at 9 month of age, there are 11 test items in Denver – II, there are 8 test items in Baroda screening test and 5 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening test are equally sensitive in identifying normal development among term LBW infants at 9 months of age.

Profile of developmental delay – assessment at 1 year of age by

Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Stand 2 Sec	150	-				
2. Stand alone	150	-				
3. Stoop and recover	150	-				
4. Crawling			150	-		
5. Raises to sit			150	-		
6. Stands by furniture			150	-		
7. Walks alone					150	-
B. LANGUAGE						
1. Dada mama specific one word	150	-				
2. Two word	150	-				
3. Adjusts to words			150	-		
4. Says dada			150	-		
C. FINE MOTOR						
1. Put block in cup	150	-				
2. Pulls string secures toy			150	-		
3. Fine prehension			150	-		
D. PERSONAL SOCIAL						
1. Waves byebye	150	-				

2. Play ball with examiner	150	-				
3. Cooperates in play			150	-		
4. Rings bell purposefully			150	-		
5. Throws ball					150	-

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 12 month of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 12 month of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 12 months of age.

Developmental delay by TDST	Developmental delay by DDST II		Total
	Yes	No	
Yes	0	0	0
No	0	150	150
	0	150	150

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at12 month of age.

For the neurodevelopmental assessment at one year of age, there are 8 test items in Denver – II, there are 9 test items in Baroda screening test and 2 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening test are equally sensitive in identifying normal development among term LBW infants at one year of age.

Profile of developmental delay – assessment at 18 months of age by Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Walk well	150	-				
2. Walk backwards	150	-				
3. Run	150	-				
4. Walk upstairs	150	-				
5. Walk with help			150	-		
6. Stands alone			150	-		
7. Walks alone			150	-		
8. Walk backwards					150	-
9. Walk upstairs with help					150	-
B. LANGUAGE						
1. Three Words	150	-				
2. Six Words	150	-				
3. Imitates words			150	-		
4. Says two words					150	-
C. FINE MOTOR						
1. Scribble	150	-				
2. Dump raisin demonstrated	150	-				
3. Midlines skills			150	-		

4. Turns pages			150	-		
5. Spontaneous scribble			150	-		
D. PERSONAL SOCIAL						
1. Imitate activities	150	-				
2. Drink from cup	150	-				
3. Help in house	150	-				
4. Use spoon or fork	150	-				
5. Remove garments	150	-				
6. Inhinits on commands			150	-		
7. Throws ball			150	-		
8. Gestures for wants			150	-		

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 18 month of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 18 month of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 18 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	150	150
	0	150	150

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 18 month of age.

For the neruodevelopmental assessment at one and half year of age, there are 13 test items in Denver – II, there are 10 test items in Baroda screening test and 3 test items in Trivandrum developmental screening test. All the test items were passed by the 150 term LBW infants. Thus it indicates that all three screening tests are equally sensitive in identifying

normal development among term LBW infants at one and half year of age.

PHASE II :- RETROSPECTIVE CROSS – SECTIONAL STUDY

Profile of developmental delay – assessment at 6 months of age by Denver II, Baroda screening test, TDST

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Equal movements	104	-				
2. Lift head	104	-				
3. Head up 45	104	-				
4. Head up 90	88	16				
5. Sit head steady	88	16				
6. Bear weight on legs	88	16				
7. Chest up arm support	88	16				
8. Roll over	88	16				
9. Pull to sit-no head lag	88	16				
10. Sit no support	88	16				
11. Arms & Legs thrust in play			104	-		
12. Lateral head movement			104	-		
13. Head erect and steady			88	16		
14. Hold head steady			88	16	88	16
15. Elevates on arms			88	16		
16. Sit with slight support			88	16		
17. Turn from back to side			88	16		
18. Rolls from back to stomach					88	16

B. LANGUAGE						
1. Respond to bell	104	-				
2. Vocalises	104	-				
3. Cooing	104	-				
4. Laughs	104	-				
5. Squeals	104	-				
6. Turn to rattling sound	88	16				
7. Turn to voice	88	16				
8. Single syllable	104	-				
9. Imitate speech	88	16				
10. Responds to sound			104	-		
11. Play with rattle			88	16		
12. Turns head to sound			88	16		
13. Turn head to sound of bell					88	16
C. FINE MOTOR						
1. Follow to midline	104	-				
2. Follow past midline	104	-				
3. Grasp rattle	104	-				
4. Hands together	88	16				
5. Follow 180	88	16				
6. Regards raisin	88	16				
7. Reaches	88	16				
8. Look for yarn	88	16				
9. Breaks raisin	88	16				
10. Passes cube	88	16				
11. Momentary regard			104	-		
12. Follows moving person			104	-		
13. Free inspection of surrounding			104	-		
14. Eye coordination			104	-		
15. Eyes follow pencil					104	-

16. Reaches for dangling ring			88	16		
17. Objects hand to hand					88	16
D. PERSONAL SOCIAL						
1. Regard face	104	-				
2. Smile responsively	104	-				
3. Smile Spontaneously	88	16				
4. Regard own hands	88	16				
5. Work for toys	88	16				
6. Feed self	88	16				
7. Social smile			104	-		
8. Recognizes mother			88	16		
9. Exploitive paper play			88	16		

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 6 months of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	16	0	16
No	0	88	88
	16	88	104

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 6 months of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 6 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	16	0	16
No	0	88	88
	16	88	104

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 6 month of age.

For the neurodevelopmental assessment at 6 months of age, there are 36 test items in Denver II, out of 104 term LBW infants, Eighty eight of them have passed all 36 items, sixteen of them have failed, 23 items out of 36 items. All the sixteen candidate were very LBW infants. In Baroda developmental screening test, there are 18 test items, out of 104 candidates, 88 of them have passed all test items, 16 of them have passed 10 items out of 18 test items, less than 50% level curve. In Trivandrum developmental screening test, there are 6 items, out of 104 candidates, 88

of them have passed all 6 items, 16 of them passed only 3 out of 6 items. Thus it indicates that all 3 screening tests are equally sensitive in finding out the developmental delay among LBW infants, at 6 months of age. The result also showed that neurodevelopmental delay was more common among very LBWs than LBW infants.

Profile of developmental delay – assessment at 9 months of age by Denver II, Baroda screening test, TDST.

Items	**Denver II**		**Baroda**		**TDST**	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Equal movements	78	-				
2. Lift head	78	-				
3. Head up 45	78	-				`
4. Head up 90	72	6				
5. Sit head steady	72	6				
6. Bear weight on legs	72	6				
7. Chest up arm support	72	6				
8. Roll over	72	6				
9. Pull to sit – no head lag	72	6				
10. Sit no support	72	6				
11. Stand Holding on	72	6				

12. Pull to stand	72	6				
13. Get to sitting	72	6				
14. Arms & legs thrust in play			78	-		
15. Lateral had movement			78	-		
16. Head erect and steady			72	6		
17. Holds head steady			72	6		
18. Elevates on arms			72	6		
19. Sit with slight support			72	6		
20. Turn from back to side			72	6		
21. Sits alone steadily			72	6		
22. Pulls to stand			72	6		
23. Sits with good coordination			72	6		
24. Rolls from back to stomach					72	6
25. Raises self to sitting position					72	6
26. Standing up by furniture					72	6
27. Walk with help					72	6
B. LANGUAGE						
1. Respond to bell	78	-				
2. Vocalizes	78	-				
3. Cooing	78	-				
4. Laughs	78	-				

5. Squeals	78	-				
6. Turn to rattling sound	72	6				
7. Turn to voice	72	6				
8. Single syllable	78	6				
9. Imitate speech sounds	72	6				
10. Dadamama non specific	72	6				
11. Combine syllables	72	6				
12. Blabbering	72	6				
13. Responds to sound			78	-		
14. Play with rattle			72	6		
15. Turns head to sound			72	6		
16. Turn head to sound of bell					72	6
C. FINE MOTOR						
1. Follow to midline	78	-				
2. Follow past midline	78	-				
3. Grasp rattle	78	-				
4. Hands together	78	-				
5. Follow 180	72	6				
6. Regards raisin	72	6				
7. Reaches	72	6				
8. Look for yarn	72	6				
9. Breaks raisin	72	6				
10. Passes cube	72	6				

11. Take 2 cubes	72	6				
12. Thumb finger grasp	72	6				
13. Bang 2 cubes held in hands	72	6				
13. Momentary regard			78	-		
14. Follows moving person			78	-		
15. Free inspection of surrounding			78	-		
16. Eye coordination			78	-		
17. Reaches for dangling ring			72	6		
18. Pulls to sit			72	6		
19. Bangs in play			72	6		
20. Retails 2 things in hands			72	6		
21. Holds head steady					72	6
22. Transfer objects hand to hand					72	6
23. Fine prehension pellet					72	6
D. PERSONAL SOCIAL						
1. Regard face	78	-				
2. Smile responsively	78	-				
3. Smile spontaneously	78	-				
4. Regard own hands	72	6				
5. Work for toys	72	6				
6. Feed Self	72	6				
7. Play pat a cake	72	6				

8. Imitate wants	72	6				
9. Social smile			78	-		
10. Recognizes mother			72	6		
11. Exploitive paper play			72	6		
12. Discriminates strangers			72	6		
13. Playful response to mirror image			72	6		
14. Pat a cake					72	6

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 9 months of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	6	0	6
No	0	72	72
	6	72	78

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 9 months of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 9 months of age.

Developmental delay by TDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	6	0	6
No	0	72	72
	6	72	78

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 9 month of age.

For the neurodevelopmental assessment at 9 month of age, In Denver II, there are 47 test items, out of 78 term LBW infants, 72 of them have passed all 47 items, 6 of them have passed only 15 out of 47 term items. All the 6 candidates who have failed the test items were very LBW infants. In the Baroda Developmental screening test, there are 26 test items. 72 of them have passed all the test items, 6 of them have passed 8 out of 26 items. In Trivandrum developmental screening test, tere are 11 test items, 72 of them have passed all test items. 6 of them

have passed one item out of 11 items. Thus all three screening tests are equally sensitive in identifying neruodevelopmental delay among term LBW infants. The result also showed that neurodevelopmental delays are more common among very LBW infants than LBW infants.

Profile of developmental delay – assessment at 1 year of age by Denver II, Baroda screening test, TDST.

Items	Denver II		Baroda		TDST	
	✓	□	✓	□	✓	□
A. GROSS MOTOR						
1. Equal movements	52	-				
2. Lift head	52	-				
3. Head up 45	52	-				
4. Head up 90	52	-				
5. Sit head steady	52	-				
6. Bear weight on legs	52	-				
7. Chest up arm support	52	-				
8. Roll over	52	-				
9. Pull to sit no head lag	52	-				
10. Sit no support	52	-				
11. Stand holding on	52	-				
12. Pull to stand	52	-				
13. Get to sitting	52	-				

14. Stand 2 sec	52	-				
15. Stand alone	52	-				
16. Stoop and recover	52	-				
17. Arms & legs thrust in play			52	-		
18. Lateral head movement			52	-		
19. Head erect and study			52	-		
20. Holds head steady			52	-		
21. Elevates on arms			52	-		
22. Sit with slight support			52	-		
23. Turns from back to side			52	-		
24. Sits alone steadily			52	-		
25. Pulls to stand			52	-		
26. Sits with good coordination			52	-		
27. Crawling			52	-		
28. Raises to sit			52	-		
29. Stands by furniture			52	-		
30. Rolls from back to stomach					52	-
31. Raises self to sitting position					52	-
32. Standing up by furniture					52	-
33. Walk with help					52	-
34. Walks alone					52	-

B. LANGUAGE						
1. Respond to bell	52	-				
2. Vocalises	52	-				
3. Cooing	52	-				
4. Laughs	52	-				
5. Squeals	52	-				
6. Turn to rattling sound	52	-				
7. Turn to voice	52	-				
8. Single syllable	52	-				
9. Imitate speech sound	52	-				
10. Dada – mama non specific	52	-				
11. Combine syllables	52	-				
12. Blabbering	52	-				
13. Dada-mama specific	52	-				
14. One word	52	-				
15. Two word	52	-				
16. Responds to sound			52	-		
17. Play with rattle			52	-		
18. Turns head to sound			52	-		
19. Adjusts to words			52	-		
20. Says dada			52	-		
21. Turn head to sound of bell					52	-

C. FINE MOTOR						
1. Follow to midline	52	-				
2. Follow past midline	52	-				
3. Grasp rattle	52	-				
4. Hands together	52	-				
5. Follow 180	52	-				
6. Regards raisin	52	-				
7. Reaches	52	-				
8. Look for yarn	52	-				
9. Breaks raisin	52	-				
10. Passes cube	52	-				
11. Take 2 cubes	52	-				
12. Thumb finger grasp	52	-				
13. Bang 2 cubes held in hands	52	-				
14. Put block in cup	52	-				
15. Momentary regard			52	-		
16. Follows moving person			52	-		
17. Free inspection of surrounding			52	-		
18. Eye coordination			52	-		
19. Reaches for dangling ring			52	-		
20. Pulls to sit			52	-		
21. Bangs in play			52	-		

22. Retails 2 things in hands			52	-		
23. Pulls string secures toy			52	-		
24. Fine prehension			52	-		
25. Eyes follow pencil					52	-
26. Objects hand to hand					52	-
27. Fine prehension pellet					52	-
D. PERSONAL SOCIAL						
1. Regard face	52	-				
2. Smile responsively	52	-				
3. Smile spontaneously	52	-				
4. Regard own hands	52	-				
5. Work for toys	52	-				
6. Feed Self	52	-				
7. Play pat a cake	52	-				
8. Imitate wants	52	-				
9. Waves byebye	52	-				
10. Play ball with examiner	52	-				
11. Social smile			52	-		
12. Recognizes mother			52	-		
13. Exploitive paper play			52	-		
14. Discriminates strangers			52	-		
15. Playful response to mirror image			52	-		
16. Cooperates in play			52	-		

. Pat a cake					52	-
18. Throws ball					52	-

Comparison of Denver Developmental Screening test II and Baroda developmental screening test for neurodevelopmental assessment at 12 months of age.

Developmental delay by BDST	**Developmental delay by DDST II**		**Total**
	Yes	**No**	
Yes	0	0	0
No	0	52	52
	0	52	52

BDST had a sensitivity of 100%, specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at 12 month of age.

Comparison of Denver developmental screening test II and Trivandrum developmental screening test for neurodevelopmental assessment at 12 months of age.

Developmental delay by TDST	Developmental delay by DDST II		Total
	Yes	No	
Yes	0	0	0
No	0	52	52
	0	52	52

TDST had a sensitivity of 100% specificity of 100% in predicting the developmental delay among term LBW infants as assessed by DDST II at12 month of age.

For the neurodevelopmental assessment at 1 year of age, there are 55 test items in Denver-II, 35 test items in Baroda screening test, 13 test items in Trivandrum developmental screening test. All the test items were passed by 52 candidates, that were assessed in the out-patient clinic department. Thus all three screening tests are equally sensitive in identifying normal development among LBW infants at one year of age.

DISCUSSION

The incidence of low birth weight is reported to be much higher in developing countries. About 25 to 35 percent of babies in india are LBW as opposed to about 5 to 7 percent of newborn in the developed country. In India alone 6 to 8 million LBW infants are born annually, and present a formidable challenge to health professionals from the point of view of preventive as well as therapeutic interventions.

The neurodevelopmental sequelae are more common in LBW babies compared to their normal weight counterparts.

Very often, their problems are identified quite late, may be at school age when only some rehabilitation measures can be taken several studies have shown that early intervention is effective in improving the developmental status.

A study conducted by Department of Pediatric Neurology, University of Heidelberg on 70 Low risk birth weight children without neurological impairment, which was a follow up study from birth to 7 years of age showed that there was an increased frequency of moderately subnormal test results (Developmental Quotient) among low birth weight infants. Even for the slightly LBW group (2000 to 2499 g), poorer language abilities

were confirmed. So, In their study, they have concluded that all LBW infants including Low risk populatios, should be included in a follow-up program in order to detect deficits early in life and begin treatment before school entry.

In our study, such Low risk population were followed up in order to detect deficits early in life.

Longitudinal studies are time consuming and have high fall out rate, as shown in the study by Bharga et al from Delhi, where of the 572 Low Birth weight babies with birth weight < 2000 gms, only 1/3 of the sample was available at 6 years. In another study from Goa on early intervention of LBW, it was noted that only half of the babies could be followed up till 1 year of age. But in our study, we were able to follow up 100% of the babies till one and year of age. None of them have lost from follow up.

A study on Neurodevelopmental, Functional and growth status of term LBW infants at 18 months of age was conducted by Department of Pediatrics, Maulana Azad Medical College and Associated Lok nayak Hospital, new Delhi. This study was done to evaluate the Neurodevelopmental functional and growth status of term infants weighing 2 Kg or less 18 months, and to analyze major medical and social factors associated with an adverse

neurodevelopmental and functional outcome. All infants were assessed for growth, audiovisual, neurological impairment and motor and mental development using Baroda developmental screening test. Term infants with birth weight of > 2.5 Kg without any Antenatal (or) neonatal complications served as control. 50 LBW term infants and 30 controls were evaluated. The mean Developmental Quotient for LBW infants [91.51 (16.97)] was significantly lower than that of control [102.02(8.4)]. Neonatal complications were associated with an abnormal motor outcome. They concluded that term LBW infants are at significant disadvantage in terms of growth and mental scores at 18 month of age.

In our study, we followed term LBW infants without any neonatal complications over a period of 18 month, since the previous study showed that term LBW infants are at significant disadvantage in terms of growth and mental scores at 18 month of age.

In our study, we also analyzed the effects of risk factors in terms of Antenatal illnesses such as Hypertension, Diabetes mellitus, Infection, etc., on LBW and their neuodevelopmental outcome.

A retrospective cohort study conducted by Mississippi department of health showed that maternal chronic Hypertension,

Diabetes and cardiac disease were significantly associated with LBW among African Americans.

A population based long term follow up study of 130 LBW infants published in Acta paediatrica (volume 95 Issue) showed that maternal chorioamnionitis, known to be associated with an increased frequency of cerebral palsy, may have lasting negative consequences for fetal brain development, resulting in long-term cognitive impairment.

In the present study, the developmental assessment was done by three standard screening tests:-

1. **Denver developmental screening test II**
2. **Baroda developmental screening test.**
3. **Trivandrum developmental screening test.**

To the best of our knowledge, there are no articles published in English literature regarding the neurodevelopmental assessment among term Low birth weight infants without any neonatal complications by using these three screening tests. Therefore we were unable to compare our results with similar studies.

This study has also compared the results of those three screening tests. There are no previous studies comparing these 3 Scales in assessing the nerurodevelopmental outcome among term LBW infants. Thus we couldn't compare our results with similar studies.

According to this present study, all three screening tests are equally sensitive and specific in identifying both normal development as well as delay among term LBW infants.

In a recent internet study, under the aegis pediatric education and communication network (PECN), 72 % European, 70% American and only 20% Indian Pediatrician said, they were routinely carrying out some form of developmental screening in their general practice.

One of the aims of our study is to identify simple, best and less time consuming screening test, so that the busy pediatrician in their outpatient clinic can use it.

The result of our study showed that Trivandrum developmental screening test, a simple developmental screening test which has 17 test items and require only a pen and a bunch of key are equally sensitive and specific in identifying neruodevelopmetnal delay as well as normal development compared to Denver developmental screening test II which

has 125 items and four domains. Hence, from our study it was concluded that Trivandrum developmental screening test can be used by the busy Indian pediatrician in their outpatient clinic for neurodevelopmental assessment.

CONCLUSION

Analysis of the results showed that in the Phase – I study, there was no developmental delay. In the Phase – II study developmental delay was observed only among very Low birth weight infants, and also there was an statistically significant association between antenatal illnesses and neurodevelopmental outcome among very Low birth weight infants.

Thus our study signifies the importance of periodic neurodevelopmental assessment of at risk population, Low birth weight infants, for early detection of neurodevelopmental delay.

For neurodevelopmental assessment at 18 month of age:-

- Denver developmental screening test II has 68 items.
- Baroda developmental screening test has 45 items.
- Trivandrum developmental screening test has 16 items.

All are equally sensitive and specific in identifying both normal development as well as neurodevelopmental delay. Thus Trivandurm developmental screening test which has only 17 test items and require only a Pen an a bunch of key are equally sensitive and specific in identifying neurodevelopmental delay as well as normal development. So the busy Indian Pediatrician can use it in their outpatient clinic for neurodevelopmental assessment at least for at risk population for early detection of neurodevelopmental delay.

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DATA COLLECTION FORM

Name :

Age :

Sex :

Date of Birth :

Birth Weight :

Length :

Head Circumference :

Chest Circumference :

Mother Name :

Age :

Qualification :

Occupation :

Father Name :

Age :

Qualification :

Occupation :

Address :

Phone No :

Para_Live_Abortion _

- First trimester:

1. Fever with rash (Yes / No)

- Second trimester:

    1. Diabetes (Yes / No)
    2. Pregnancy induced hypertension
    3. Cardiac Disease

- Third Trimester:

    1. Bleeding (Yes / No)
    2. Infection (Yes / No)

From the records:

- Hb% ----------
- Antenatal USG ----------

Labour:

- Twin (Yes / No)
- Presentation (Breech / vertex / others)
- Meconium stained liquor (Yes / No)
- Mode of delivery (Vaginal / LSCS / forceps)
- Duration of labour (Yes / No)
- Prolonged rupture of membrane (Yes / No)
- Cord around the neck (Yes / No)

APGAR SCORE:

- Cried immediately after birth : (Yes / No)

Hospital stay:

No. of days Seizure : (Yes / No)

Jaundice (Yes / No)

If yes : (Physiological / pathological)
(Photo therapy / Exchange transfusion)

Sepsis : (Yes / No)

HIE : (Yes / No)

DEVELOPMENTAL ASSESSMENT

CARD

ID. No. :

Name :

Age :

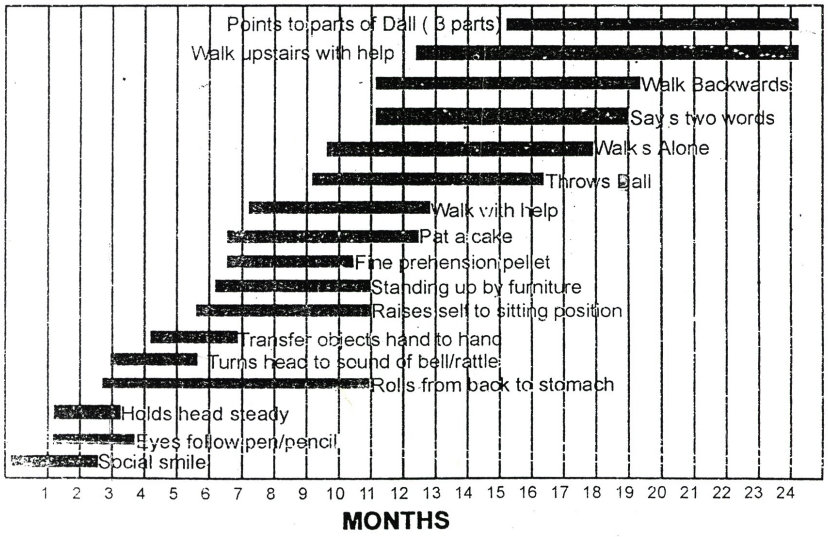
Sex :

Date of Birth :

Birth Weight :

Age	Date (Follow-up)	Done on	DDST		BDST		TDST	
			N	D	N	D	N	D
3 Month								
6 Month								
9 Month								
12 Month								
18 Month								

Trivandrum Developmental Screening Chart (TDSC)



Based on BSID Baroda norms. MKC Nair, Babu George, Elsie Philip, Indian Pediatr 1991, 28 : 869-72
Child Development Centre, SAT Hospital, Thiruvananthapuram

Denver Developmental Screening Test-II

Growth and Development

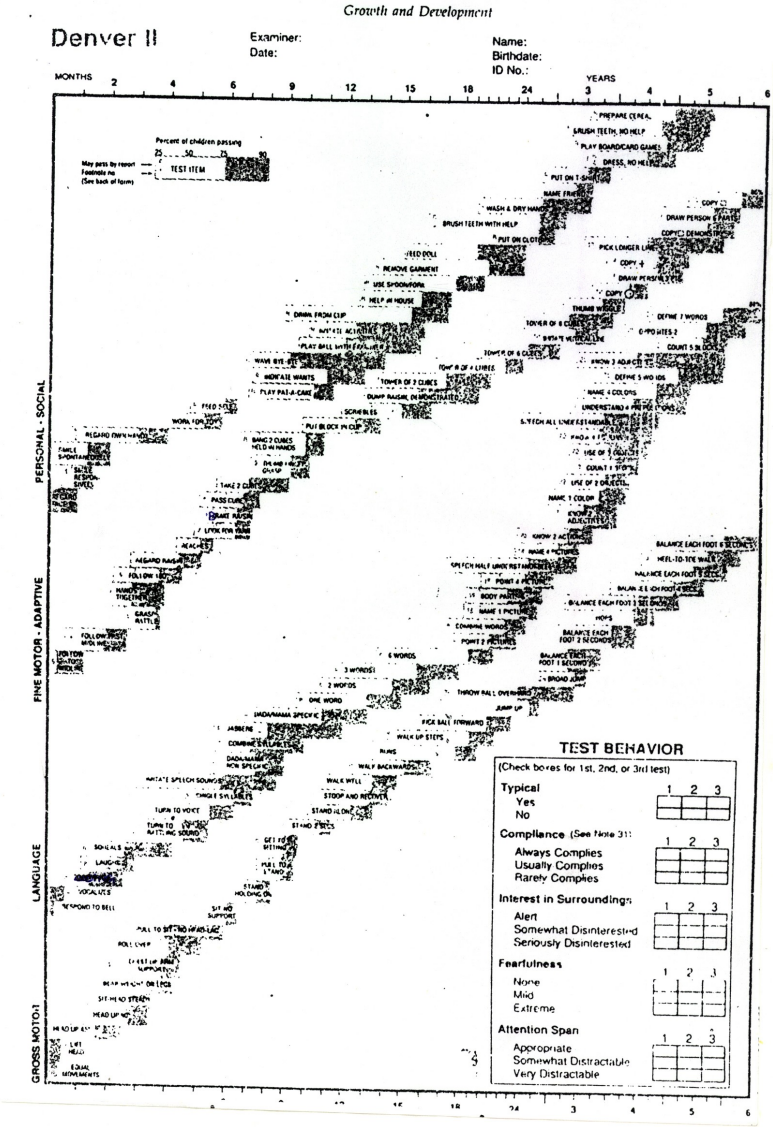


TABLE I—*Screening Test Items with Serial Numbering and Age Grouping: The Corresponding Number on the Motor (*) and Mental (without asterick) Scales of BSID and the 50% and 97% Age Placements are also Presented*

Age group (mo)	Sr. No.	Items	BSID No.	Age placements (mo)	
				50%	97%
1	1.	Arms and legs thrust in play	*3, 4	0.5	1.0
	2.	Momentary regard	1	0.5	1.0
	3.	Lateral head movement (prone)	*5	0.6	1.1
2	4.	Responds to sound	5, 7, 8	0.6	1.1
	5.	Follows moving person	10	0.7	1.6
	6.	Free inspection of surrounding	12	0.8	1.9
3	7.	Social smile/vocalises	19, 20	1.4	2.9
	8.	Eye co-ordination	13, 14, 15, 18	1.4	3.0
	9.	Head erect and steady	*10	1.5	3.1
4	10.	Holds head steady	*14	2.2	3.7
	11.	Recognises mother	28	2.3	3.8
	12.	Elevates on arms	*13	1.9	3.9
5	13.	Play with rattle/hand play	37, 38	2.9	4.7
	14.	Reaches for dangling ring	36	2.8	4.9
	15.	Sits with slight support	*16	2.8	4.9
6	16.	Turns head to sound	46, 47	3.9	5.7
	17.	Turns from back to side	*18	3.4	5.8
	18.	Exploitive paper play	52	4.4	5.9
7	19.	Discriminates strangers	59	4.9	6.9
	20.	Pulls to sit	*22	4.9	6.9
8	21.	Bangs in play	69	5.6	7.0
	22.	Sits alone steadily	*30	6.2	7.9
9	23.	Retails two things in two hands	75	6.1	8.6
	24.	Pulls to stand	*29	6.1	9.0
	25.	Playful response to mirror image	76	6.3	9.2
	26.	Sits with good co-ordination	*31	6.5	9.2
10	27.	Pulls string-secures toy	81	7.1	9.4
	28.	Co-operates in play	79	6.9	9.9
	29.	Crawling (pre-walking)	*35	6.9	10.0
11	30.	Rings bell purposefully	85	7.7	10.7
	31.	Fine prehension	*41	8.6	10.9

TABLE I *(Contd.)*

Age group (mo)	Sr. No.	Items	BSID No.	Age placements (mo)	
				50%	97%
	32.	Raises to sit	*37	8.2	11.0
	33.	Stands by furniture	*40	8.5	11.0
12	34.	Adjusts to words	85	8.3	11.7
	35.	Says da-da	88	9.0	11.9
13 to 15	36.	Inhinits on command	90	9.7	12.6
	37.	Midline skills	*42	9.4	12.7
	38.	Walks with help	*43	9.7	13.0
	39.	Turns pages	100	11.0	13.9
16 to 18	40.	Imitates words	103	11.9	15.7
	41.	Stands alone	*45	10.8	15.9
	42.	Spontaneous scribble	108	13.1	16.5
	43.	Throws Ball	*48	12.6	16.7
	44.	Aufstein I	*46	12.3	17.3
	45.	Walks alone	*47	12.5	17.4
	46.	Gestures for wants	112	13.7	18.3
19 to 24	47.	Shows shoes, *etc.*	115	14.1	18.8
	48.	Two words	114	14.1	19.1
	49.	Walks up and down stairs with help	*53, 54	16.5	24.5
	50.	Words for wants	124	17.5	24.8
25 to 30	51.	Two word sentences	134	21.2	28.8
	52.	Names three objects	144	24.1	29.0
	53.	Stands on one foot	*60, 61	26.6	29.0
	54.	Walks up and down stairs without help	*57, 58	24.4	29.6

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The dissertation committee for 2006, Institute of Child health and Hospital for Children, Madras Medical College, Chennai comprising of the following members has granted permission to MD post-graduate Dr.S.Yuvarani to proceed with her study titled **"Comparison of two screening tests in evaluating neurodevelopmental outcome among term low birth weight infants"** after carefully scrutinizing his / her study proposal with special reference to ethical standards, methodology and relevance. His / Her study proposal was approved on 07.10.2006

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